SG27
REV 3

Tuning and Switching Diode

Selector Guide

MOTOROLA

Motorola Tuning/Switching Diodes

Motorola tuning diodes encompass the following products — General Purpose Abrupt Junction Tuning Diodes and High Capacitance and/or Hyper-Abrupt Junction Tuning Diodes. These devices offer a wide selection of capacitance values ranging from 6.8 pF to 560 pF. Also a part of the Motorola tuning diode family are PIN Switching and Hot Carrier (Schottky) Diodes, which are available for many fast and low level switching applications.

These diodes are offered in a variety of glass and plastic packaging for both insertion and surface mount applications. The popular DO-7 (Case 51) and DO-14 (Case 146) axial lead packages are a large portion of the product selection. The lower priced 2-leaded TO-92 (Case 182) and 3-leaded TO-92 (Case 29) are available for High Capacitance Hyper-Abrupt and PIN Switching Diodes. The SOT-23 (Case 318) is offered for surface mount applications and is available in two lead forms, standard and low profile. The SOT-23 is also available in 8 mm tape and reel for automated assembly operations.

The products listed in this selector guide are tested according to standard specifications. The following tables are grouped by diode type to make it easy for you to select the diode that will fulfill your application requirement. Motorola also offers special electrical selection of these devices. Please contact your Motorola Sales Representative regarding any special request that you may have.

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Parameter Test Methods

1. **L_S, SERIES INDUCTANCE**
   L_S is measured on a shorted package at 250 MHz using an impedance bridge (Boonton Radio Model 250A RX Meter).

2. **C_C, CASE CAPACITANCE**
   C_C is measured on an open package at 1 MHz using a capacitance bridge (Boonton Electronics Model 75A or equivalent).

3. **C_T, DIODE CAPACITANCE**
   ($C_T = C_C + C_J$). C_T is measured at 1 MHz using a capacitance bridge (Boonton Electronics Model 75A or equivalent).

4. **TR, TUNING RATIO**
   TR is the ratio of C_T measured at Lower Reverse Voltage divided by C_T measured at the Higher Reverse Voltage.

5. **Q, FIGURE OF MERIT**
   Q is calculated by taking the G and C readings of an admittance bridge at the specified frequency and substituting in the following equations:

$$Q = \frac{2\pi fC}{G}$$

   (Boonton Electronics Model 33AS8). Use Lead Length $\approx$ 1/16".

6. **TC_C, DIODE CAPACITANCE TEMPERATURE COEFFICIENT**
   TC_C is guranteed by comparing C_T at V_R = 4 Vdc, f = 1 MHz, T_A = −40°C with C_T at V_R = 4 Vdc, f = 1 MHz, T_A = +85°C in the following equation which defines TC_C:

$$TC_C = \frac{C_T(+85°C) - C_T(-40°C)}{85 + 40} \quad \frac{10^6}{C_R(25°C)}$$

   Accuracy limited by measurement of C_T to ±0.1 pF.

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1N5463A	4
1N5464A	4
1N5465A	4
1N5466A	4
1N5467A	4
1N5468A	4
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1N5470A	4
1N5471A	4
1N5472A	4
1N5473A	4
1N5474A	4
1N5475A	4
1N5476A	4
MBAL99	9
MBAS16	9
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MBAV74	9
MBAV99	9
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MBD301	10
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MV1626	5
MV1628	5
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MV1636	5
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MV1642	5
MV1644	5
MV1646	5
MV1648	5
MV1650	5
MV2101	6
MV2102	6
MV2103	6
MV2104	6
MV2105	6
MV2106	6
MV2107	6
MV2108	6
MV2109	6
MV2110	6
MV2111	6
MV2112	6
MV2113	6
MV2114	6
MV2115	6
MV2201	6
MV2203	6
MV2205	6
MV2207	6
MV2209	6
MV2211	6
MV2212	6
MV2213	6
MV2215	6
MVAM108	9
MVAM109	9
MVAM115	9
MVAM125	9

General Purpose Abrupt Junction Tuning Diodes

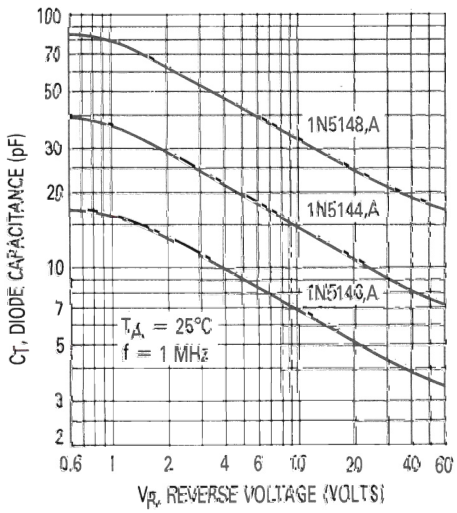
Voltage variable capacitance diodes for electronic tuning and control of RF circuits through UHF frequencies. Utilized for television tuning and AFC circuits.

CASE 51-02
(DO-204AA)
DO-7

		• High Q • Capacitance TOL 10% — No Suffix 5% — Suffix A			• Premium 30 V • Very High Q • Guaranteed High CR • Capacitance TOL 10% – A, 5% – B, 2% – C		
		Maximum Working Voltage					
		60 Volts			30 Volts		
		Cap Ratio C4/C60 Min	**Q @ 4 V 50 MHz Min**	**Device Type**	**Cap Ratio C2/C30 Min**	**Q @ 4 V 50 MHz Min**	**Device Type**
C_T Nominal Capacitance pF ±10% @ V_R = 4 V f = 1 MHz	**6.8**	2.7	350	1N5139,A	2.7	600	1N5461A
	8.2				2.8	600	1N5462A
	10	2.8	300	1N5140,A	2.8	550	1N5463A
	12	2.8	300	1N5141,A	2.8	550	1N5464A
	15	2.8	250	1N5142,A	2.8	550	1N5465A
	18	2.8	250	1N5143,A	2.9	500	1N5466A
	20				2.9	500	1N5467A
	22	3.2	200	1N5144,A	2.9	500	1N5468A
	27	3.2	200	1N5145,A	2.9	500	1N5469A
	33	3.2	200	1N5146,A	2.9	500	1N5470A
	39	3.2	200	1N5147,A	2.9	450	1N5471A
	47	3.2	200	1N5148,A	2.9	400	1N5472A
	56				2.9	300	1N5473A
	68				2.9	250	1N5474A
	82				2.9	225	1N5475A
	100				2.9	200	1N5476A

TYPICAL CHARACTERISTICS

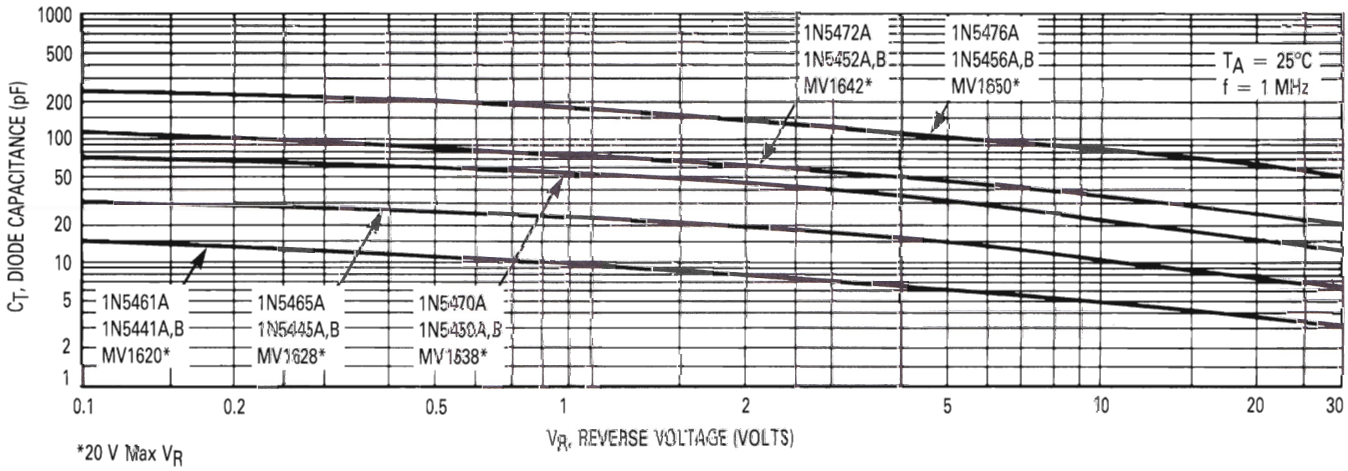
Diode Capacitance versus Reverse Voltage



• High Q • Controlled CR • Capacitance TOL 10% – A, 5% – B, 2% – C			• General-Purpose			
Maximum Working Voltage						
30 Volts			20 Volts			
Cap Ratio C2/C30 Min	**Q @ 4 V 50 MHz Min**	**Device Type**	**Cap Ratio C2/C20 Min**	**Q @ 4 V 50 MHz Min**	**Device Type**	**C_T Nom pF**
2.5	450	1N5441A,B	2	300	MV1620	6.8
2.5	450	1N5442A,B	2	300	MV1622	8.2
2.6	400	1N5443A,B	2	300	MV1624	10
2.6	400	1N5444A,B	2	300	MV1626	12
2.6	450	1N5445A,B	2	250	MV1628	15
2.6	350	1N5446A,B	2	250	MV1630	18
2.6	350	1N5447A,B	2	250	MV1632	20
2.6	350	1N5448A,B	2	250	MV1634	22
2.6	350	1N5449A,B	2	200	MV1636	27
2.6	350	1N5450A,B	2	200	MV1638	33
2.6	300	1N5451A,B	2	200	MV1640	39
2.6	250	1N5452A,B	2	200	MV1642	47
2.6	200	1N5453A,B	2	150	MV1644	56
2.7	175	1N5454A,B	2	150	MV1646	68
2.7	175	1N5455A,B	2	150	MV1648	82
2.7	175	1N5456A,B	2	150	MV1650	100

TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage



*20 V Max V_R

General Purpose Abrupt Junction Tuning Diodes (continued)

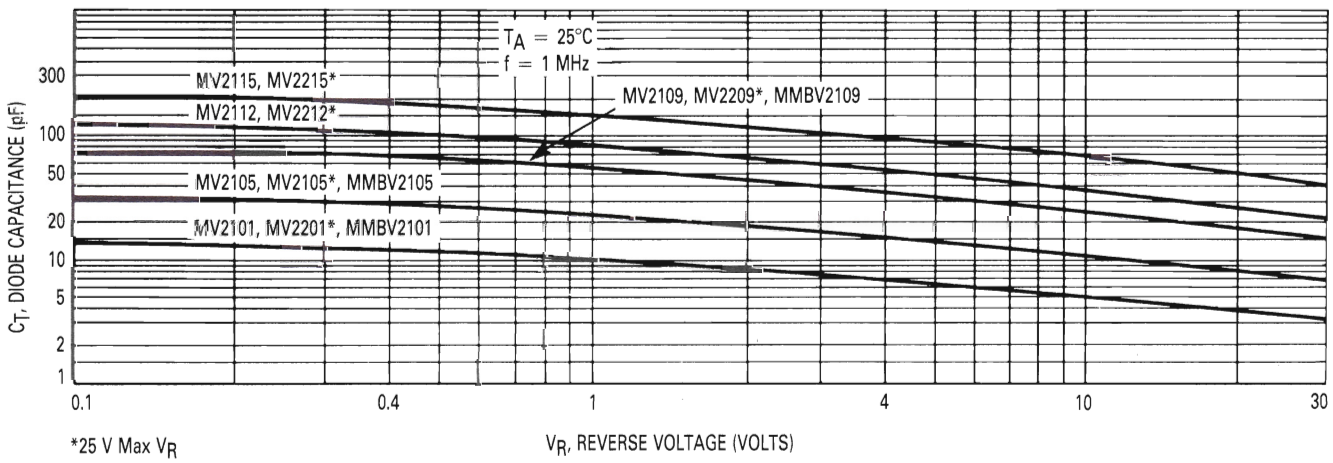
CASE 182-02
(TO-226AC)
TO-92
Style 1

CASE 318-02
(TO-236AA)
Style 8

		• Low-Cost • High Volume			• Lower Cost • General-Purpose			• Low-Cost • High Volume			
		Maximum Working Voltage									
		30 Volts			25 Volts			30 Volts			
		CASE 182-02 2-Lead TO-92						CASE 318-02 TO-236AA			
		Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Min	Device Type	Cap Ratio C1/C10 Min	Q @ 4 V 50 MHz Min	Device Type C_T ±20%	Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Typ	Device Type	C_T Nom pF
C_T Nominal Capacitance pF ±10% @ V_R = 4 V f = 1 MHz	6.8	2.5	450	MV2101	1.9	300	MV2201	2.5	400	MMBV2101	6.8
	8.2	2.5	450	MV2102				2.5	350	MMBV2102	8.2
	10	2.5	400	MV2103	2	200	MV2203	2.5	350	MMBV2103	10
	12	2.5	400	MV2104				2.5	350	MMBV2104	12
	15	2.5	400	MV2105	2	200	MV2205	2.5	350	MMBV2105	15
	18	2.5	350	MV2106				2.5	300	MMBV2106	18
	22	2.5	350	MV2107	2	150	MV2207	2.5	300	MMBV2107	22
	27	2.5	300	MV2108				2.5	250	MMBV2108	27
	33	2.5	200	MV2109	2	150	MV2209	2.5	200	MMBV2109	33
	39	2.5	150	MV2110							39
	47	2.5	150	MV2111	2	100	MV2211				47
	56	2.6	150	MV2112							56
	68	2.6	150	MV2113	2	100	MV2213				68
	82	2.6	100	MV2114							82
	100	2.6	100	MV2115	2	50	MV2215				100

TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage



*25 V Max V_R

General Purpose Abrupt Junction Tuning Diodes (continued)

CASE 318-03
(TO-236AB)
Style 9

Style 15
CASE 29-02
(TO-226AA)
TO-92

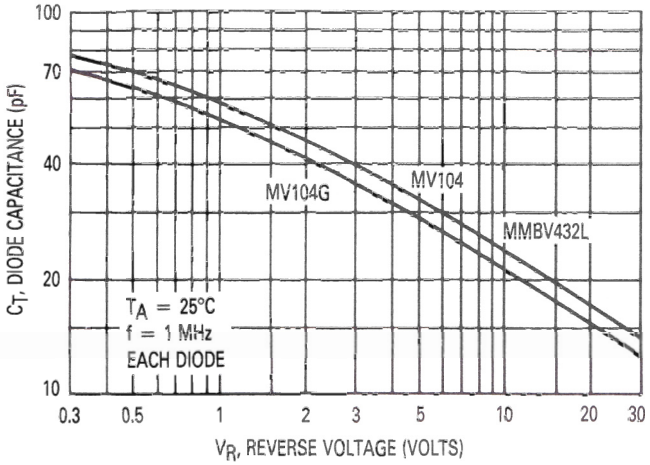
- High Q
- Guaranteed Capacitance Range
- Monolithic Dual

Maximum Working Voltage
32 Volts**

C_T Capacitance pF		@ V_R	Cap Ratio C3/C30	Q @ 3 V 50 MHz	Device Type
Min	Max	Volts	Min	Min	
34	39	3	2.5	100	MV104G
37	42	3	2.5	100	MV104
43	48.1	2	1.5*	100	MMBV432L(1)

(1) Case 318 *C2/C8 **MMBV432L Max Working Voltage = 14V

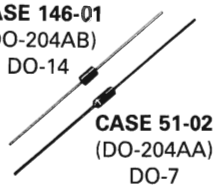
TYPICAL CHARACTERISTICS
Diode Capacitance versus Reverse Voltage



High Capacitance Hyper-Abrupt Junction Tuning Diodes

This next section covers High Capacitance and/or Hyper-Abrupt Junction Tuning Diodes, which are designed for AM/FM tuning, general frequency control, and tuning and detuning for minimum signal distortion.

CASE 146-01
(DO-204AB)
DO-14



CASE 51-02
(DO-204AA)
DO-7

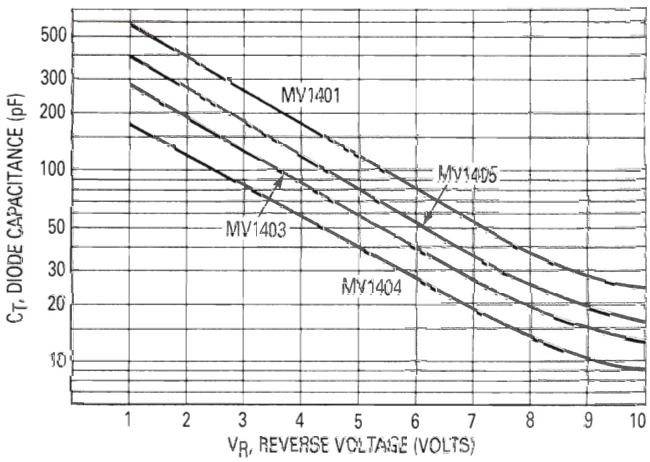
- Hyper-Abrupt
- High Tuning Ratio
- High Rel — Suffix H

Maximum Working Voltage
12 Volts

C_T, Nominal Capacitance pF Nom ± 20%	@ V_R Volts	Cap Ratio C2/C10 Min	Q @ 2 V 1 MHz Min	Device Type	
120	2	10	200	MV1404,H**	
175	2	10	200	MV1403,H**	
250	2	10	200	MV1405,H**	
550***	1	14(2)	200		MV1401,H*

*Case 146 **Case 51 ***±15% (2)Cap Ratio @ C1/C10 V

TYPICAL CHARACTERISTICS
Diode Capacitance versus Reverse Voltage



100% Screening On "H" Devices for High Reliability

Internal Visual Inspection
per 12M53957B — DO-7 only

High Temperature Storage
T_A = 200°C, t ≥ 48 hours

Thermal Shock (Temperature Cycling)
MIL-STD-202, Method 107, Condition C except 10 cycles continuously performed
t(extremes) = 15 minutes

Constant Acceleration
MIL-STD-750, Method 2006
20,000 G's Y1 axis only

Hermetic Seal
MIL-STD-750, Method 1071
Fine Leak — Condition G
Gross Leak — Condition C, Step 1

Electrical Test
I_R and C_T

High Temperature Reverse Bias
T_A = 120°C ±5°C, t ≥ 96 hours
V_R = approximately 80% of MWV
Lower temperature till T_A = 30 ±5°C.
Maintain this temperature prior to removal of Reverse Bias Voltage. Perform Limit 2 Electrical Test within 24 hours following bias removal.

Electrical Test
I_R and C_T

Hyper-Abrupt Junction Tuning Diodes

FM Radio and TV

Style 8
CASE 318-02
(TO-236AA)

Style 1
CASE 182-02
(TO-226AC)
TO-92

- High Q
- Guaranteed Capacitance Range

Maximum Working Voltage

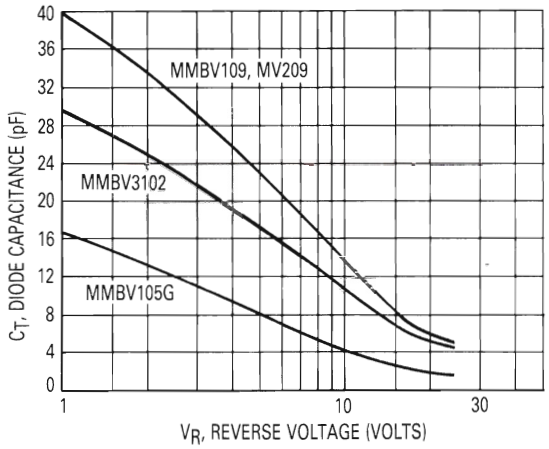
30 Volts

C_T Capacitance pF @ V_R Volts			Cap Ratio C3/C25 Min	Q @ 3 V 50 MHz Typ	Device Type
Min	Max				
1.8	2.8	25	4	350	MMBV105G*
20	25	3	4.5	300	MMBV3102*
26	32	3	5	250	MMBV109*
26	32	3	5	250	MV209**

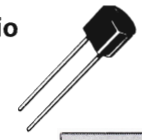
*Case 318 **Case 182

TYPICAL CHARACTERISTICS

Diode Capacitance



AM Radio



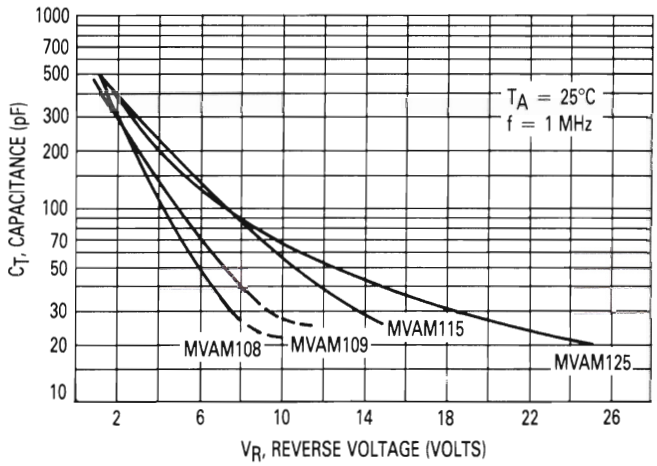
Style 1
CASE 182-02
(TO-226AC)
TO-92

- High Capacitance Ratio
- Guaranteed Diode Capacitance
- Close Matching

C_T		Q @ 1 Vdc, 1 MHz = 150 (Min)			
V_R = 1 V, f = 1 MHz pF		$V_{BR(R)}$ Min	Cap Ratio Min @	V_R Volts	Device Type
Min	Max				
440	560	12	15	1/8	MVAM108
400	520	15	12	1/9	MVAM109
440	560	18	15	1/15	MVAM115
440	560	28	15	1/25	MVAM125

TYPICAL CHARACTERISTICS

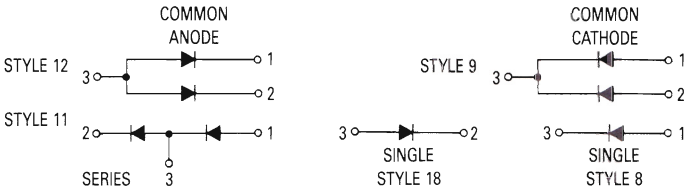
Diode Capacitance versus Reverse Voltage



Surface Mount Switching Diodes

General Purpose Diodes

CASE 318-02
(TO-236AA)



Device	$V_{(BR)R}$ Min (V)	$V_{(BR)R}$ @ I_{BR} (μA)	I_R Max (μA)	I_R @ V_R (V)	V_F Min (V)	V_F Max (V)	V_F @ I_F (mA)	C_T Max (pF)	t_{rr} Max (ns)	Pin Out Case Style
SINGLES										
MMBD6050	70	100	0.1	50	0.85	1.1	100	2.5	15	8
MMBD914	100	100	5	75		1	10	4	15	8
			0.50	20						
MBAS16	75	100	1	75		1.3	100	2	15	8
DUALS										
MBAV70	70	100	5	70		1.1	50	1.5	15	9
MBAW56			2.5							12
MBAV99										11
MBAL99										18
MBAV74	50	5	0.1	50		1	100	2		9
MMBD2835	35	100	0.1	30		1	10	4	15	12
MMBD2836	75			50						
MMBD2837	35	100	0.1	30		1	10	4	15	9
MMBD2838	75			50						
MMBD6100	70	100	0.1	50	0.85	1.1	100	2.5	15	9
MMBD7000	100		0.3		0.75			1.5		11

Fast Recovery and PIN Switching Diodes

. . . designed for VHF band switching and general-purpose switching.

Style 1

CASE 182-02
(TO-226AC)
TO-92
MPN3404
MPN3700

Style 8

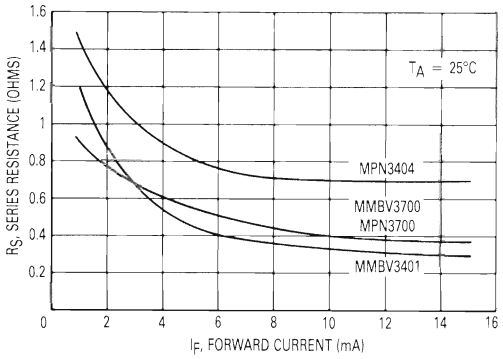
CASE 318-02
(TO-236AA)

MMBV3401
MMBV3700

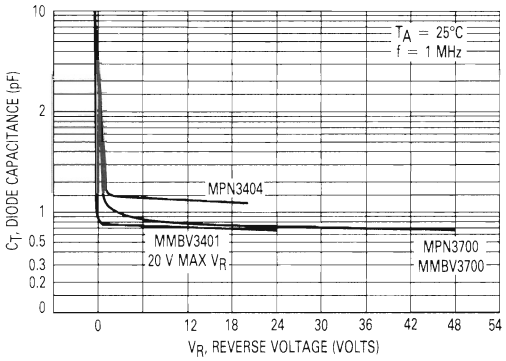
$V_{(BR)R}$ I_R = 10 μAdc Volts Min	R_S I_F = 10 mAdc f = 100 MHz Ohms Max	C_T V_R = 20 V f = 1 MHz pF Max	Device Type
20	0.85	2	MPN3404
35	0.7	1	MMBV3401
200	1	1	MPN3700
200	1	1	MMBV3700

TYPICAL CHARACTERISTICS

Series Resistance versus Forward Current



Diode Capacitance versus Reverse Voltage



Hot-Carrier (Schottky) Diodes

CASE 182-02
(TO-226AC)
TO-92

CASE 318-02
(TO-236AA)
Standard

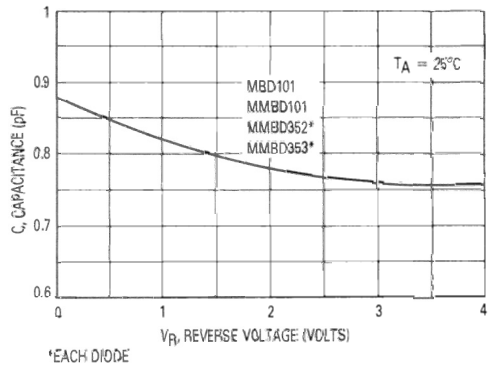
Hot-Carrier diodes are ideal for VHF and UHF mixer and detector applications as well as many higher frequency applications. They provide stable electrical characteristics by eliminating the point-contact diode presently used in many applications.

$V_{(BR)R}$ I_R = 10 μA Volts Min	C_T f = 1 MHz pF Max	@ V_R Volts	V_F I_F = 10 mA Volts Max	I_R nA Max	@ V_R Volts	Device Type	Case	Package Style
4	1	0	0.6	250	3	MBD101	182	1
4	1	0	0.6	250	3	MMBD101	318	8
4	1	0	0.6	250	3	MMBD352*	318	11
4	1	0	0.6	250	3	MMBD353*	318	19
20	1.5	15	0.6	200	15	MBD201	182	1
20	1.5	15	0.6	200	15	MMBD201	318	8
30	1.5	15	0.6	200	25	MBD301	182	1
30	1.5	15	0.6	200	25	MMBD301	318	8
50	1	20	1.2	200	25	MBD501	182	1
50	1	20	1.2	200	25	MMBD501	318	8
70	1	20	1.2	200	35	MBD701	182	1
70	1	20	1.2	200	35	MMBD701	318	8

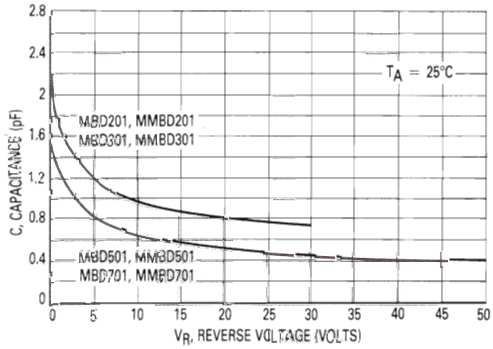
*Dual

TYPICAL CHARACTERISTICS

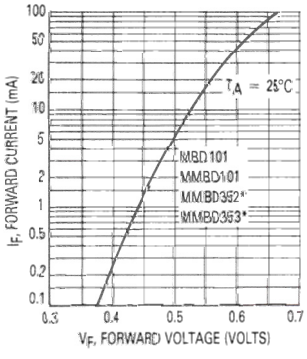
Capacitance versus Reverse Voltage

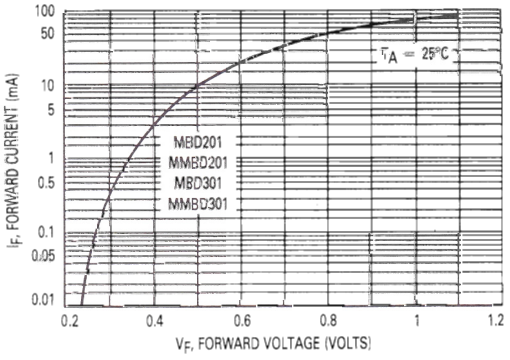


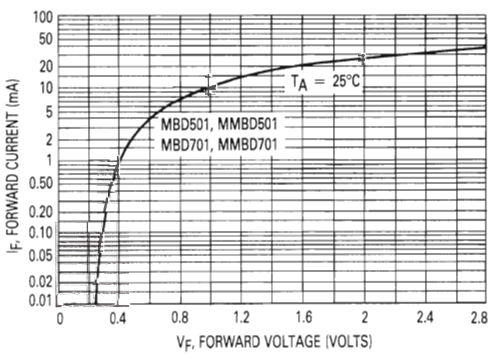
*EACH DIODE



Forward Current versus Forward Voltage



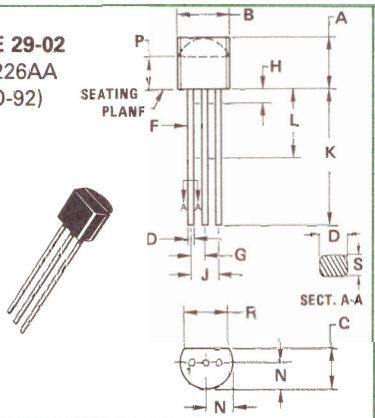




*EACH DIODE

Case Outline

CASE 29-02
TO-226AA
(TO-92)

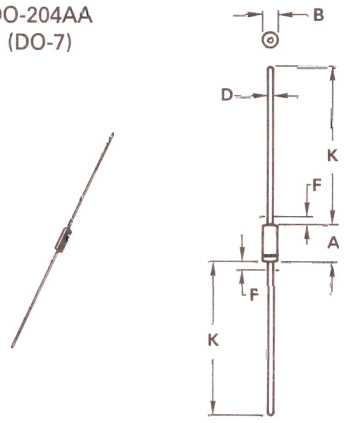


DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.32	5.33	0.170	0.210
B	4.44	5.21	0.175	0.205
C	3.18	4.19	0.125	0.165
D	0.41	0.56	0.016	0.022
F	0.41	0.48	0.016	0.019
G	1.14	1.40	0.045	0.055
H	—	2.54	—	0.100
J	2.41	2.67	0.095	0.105
K	12.70	—	0.500	—
L	6.35	—	0.250	—
N	2.03	2.67	0.080	0.105
P	2.92	—	0.115	—
R	3.43	—	0.135	—
S	0.36	0.41	0.014	0.016

STYLE 15:
PIN 1. ANODE 1
2. CATHODE
3. ANODE 2

All JEDEC dimensions and notes apply.

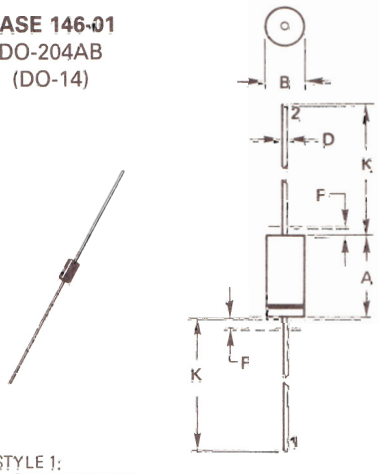
CASE 51-02
DO-204AA
(DO-7)



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.84	7.62	0.230	0.300
B	2.16	2.72	0.085	0.107
D	0.46	0.56	0.018	0.022
F	—	1.27	—	0.050
K	25.40	38.10	1.000	1.500

All JEDEC dimensions and notes apply

CASE 146-01
DO-204AB
(DO-14)

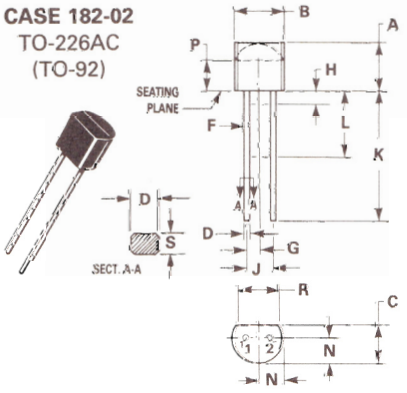


STYLE 1:
PIN 1. CATHODE
2. ANODE

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.84	7.62	0.230	0.300
B	2.74	3.56	0.108	0.140
D	0.46	0.56	0.018	0.022
F	—	1.27	—	0.050
K	25.40	—	1.000	—

All JEDEC dimensions and notes apply.

CASE 182-02
TO-226AC
(TO-92)

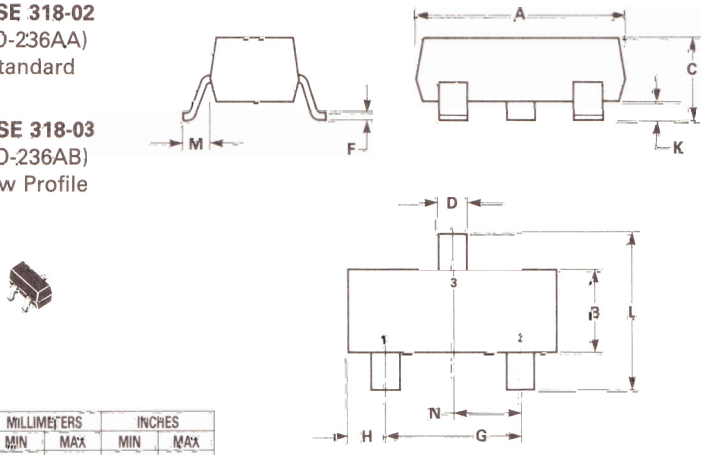


DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.32	5.33	0.170	0.210
B	4.45	5.21	0.175	0.205
C	3.18	4.19	0.125	0.165
D	0.41	0.56	0.016	0.022
F	0.407	0.482	0.016	0.019
G	1.27 BSC		0.050 BSC	
H	—	1.27	—	0.050
J	2.54 BSC		0.100 BSC	
K	12.70	—	0.500	—
L	6.35	—	0.250	—
N	2.03	2.66	0.080	0.105
P	2.93	—	0.115	—
R	3.43	—	0.135	—
S	0.36	0.41	0.014	0.016

STYLE 1:
PIN 1. ANODE
2. CATHODE

CASE 318-02
(TO-236AA)
Standard

CASE 318-03
(TO-236AB)
Low Profile



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	2.80	3.04	0.1102	0.1197
B	1.20	1.40	0.0472	0.0551
C	0.95	1.20	0.0333	0.0472
D	0.37	0.50	0.0150	0.0200
F	0.085	0.180	0.0034	0.0051
G	1.78	2.04	0.0701	0.0807
H	0.45	0.60	0.0177	0.0236
K	0.10	0.25	0.0040	0.0098
L	2.70	2.90	0.0830	0.0984
M	0.45	0.60	0.0180	0.0236
N	1.90	2.10	0.0350	0.0401
K	0.013	0.10	0.0005	0.0040

*Low Profile = CASE 318-03 TO-236AB

STYLE 8:
PIN 1. ANODE
2. NO CONNECTION
3. CATHODE

STYLE 9:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 11:
PIN 1. ANODE
2. CATHODE
3. CATHODE-ANODE

STYLE 19:
PIN 1. CATHODE
2. ANODE
3. CATHODE — ANODE

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